Appendix A
Sediment Sampling and Analysis Plan and Quality Assurance/ Quality Control Plan

I & J Waterway Sediments RI/FS
Bellingham, Washington

Prepared by:

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RETEC Project Number: PORTB-18449-100

Prepared for:

Port of Bellingham
1801 Roeder Avenue
Bellingham, Washington 98225

July 27, 2005

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July 27, 2005

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List of Acronyms

CLP	Contract Laboratory Program
COC	Chain of Custody
CVAA	Cold Vapor Atomic Absorption
DGPS	Differential Global Positioning System
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
HSP	Health and Safety Plan
ICP	Inductively-Coupled Plasma Emission Spectroscopy
MDL	Method Detection Limit
MLLW	Mean Lower Low Water
MS/MSD	Matrix spike/matrix spike duplicate
MSS	Marine Sampling Systems
MTCA	Model Toxics Control Act
NAD	North American Datum
PSAMP	Puget Sound Ambient Monitoring Program
PSDDA	Puget Sound Dredge Disposal Analysis
PSEP	Puget Sound Estuary Program
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
RI/FS	Remedial Investigation/Feasibility Study
SAP	Sampling and Analysis Plan
SMARM	Sediment Management Annual Review Meetings
SMS	Sediment Management Standards
SQS	Sediment Quality Standards
TAD	Total Acid Digestion
TOC	Total Organic Carbon
VOCs	Volatile Organic Compounds

1 Introduction

1.1 Purpose

This Sampling and Analysis Plan (SAP) summarizes the methods for field investigations to be performed during a remedial investigation and feasibility study (RI/FS) for sediments at the I & J Waterway Site (Site) in Bellingham, Washington. Figure 1-1 shows the Site location map. These methods will be used to implement the scope of work defined in the attached RI/FS Work Plan.

Expanding upon previous studies, the RI/FS investigations described in this document will define the areas and volumes of impacted sediments and will collect additional information needed to support the analysis of remedial alternatives for the Site. The RI/FS is being performed in compliance with the requirements of the Model Toxics Control Act (MTCA) and the Sediment Management Standards (SMS).

The field activities will be conducted by The RETEC Group, Inc. (RETEC), on behalf of the Port of Bellingham (Port). Field sampling activities are currently scheduled to begin in August 2005.

This document includes the elements of a sediment SAP and a quality assurance and quality control plan (QAPP) consistent with Sediment Management Standards (SMS) requirements contained in Washington Administrative Code (WAC) Chapter 173-204 (Ecology, 1995).

1.2 Investigation Areas and Tasks

The RI/FS sediment investigations will be conducted in two phased events. The first phase will consist of surface grabs and bioassay testing as described in this document. The second phase will consist of subsurface coring and required biological testing as designated under PSDDA guidelines. The second phase of sampling is attached in a separate SAP in Appendix B. If the spatial extent of contamination has not been determined in the first phase of grabs, additional investigation may be necessary. Phasing of discrete tasks and laboratory analyses are described below. Locations of surface sediment sampling locations are depicted in Figure 1-2.

Surface Grab Sampling

The spatial extent of contaminated sediments will be determined by collecting 13 surface grab samples (0-12 cm) located throughout the Site, including the inner waterway, outer waterway, and northwestern (opposite shore) boundaries. Surface grab samples will be analyzed for the chemical parameters listed below.

Chemical Analysis of Surface Grab Samples

Thirteen locations will be sampled by hydraulic van Veen. Sampling methods are described in Section 2 of this document.

The surface grabs will be analyzed for SMS chemical parameters, including semivolatile organics, metals (including nickel), total organic carbon (TOC), total sulfides, grain size, and total solids. If any surface samples should exceed SQS chemical criteria, those stations will be subjected to bioassay testing as will those determined by Ecology. Samples with nickel exceeding the PSDDA screening levels will also be tested for potential biological effects.

Bioassay Sampling

At each of the grab sampling locations shown in Figure 1-2, additional volume will be collected and archived. These archived samples will be used to perform bioassays if exceedances of the chemical SQS criteria are detected or as determined by Ecology. These bioassays will be performed as described in Section 4 of this document.

Under SMS regulations, the interpretation of bioassay data requires the collection and analysis of clean reference sediment, similar in physical characteristics to the test sediments. One or more reference samples will be collected from Samish Bay *a priori* based on similar grain size and organic carbon content of site sediment. These samples will be analyzed for chemical parameters during the first phase of sample analysis, with bioassay testing to be conducted in parallel with the test samples as described above.

Subsurface Core Sampling

A second phase of fieldwork will occur following establishment of the spatial extent of surface sediment contamination. The sediment sampling and analysis plan for subsurface cores is contained in Appendix B. The outlines of the preliminary dredged material management units developed for the RI/FS and used as the basis for the subsurface sampling effort are shown in Figure 1-2 for reference.

2 Sediment Sample Collection

This section outlines the activities, procedures, and objectives for surface sediment sampling at the Site. Field activities will be conducted in accordance with the SAP. Surface sediment will be collected from each of the proposed locations provided on Figure 1-2. Table 2-1 lists the proposed station coordinates (in both state plane coordinates and latitude/longitude). Table 2-2 lists samples to be collected at each station and the associated chemical, biological, and physical analyses. These activities are discussed below.

Specific sampling equipment and methodology may change based on sediment characteristics and Site conditions. Modifications and/or deviations from the approved SAP will be documented in the summary report and revised RI/FS. Sampling and analysis will follow PSEP (PSEP, 1986, 1995, 1996a, 1996b, 1996c, 1996d).

2.1 Navigation, Positioning, and Location Control

Positioning and navigation for sediment sample locations will be accomplished using a Real Time Kinematic (RTK) Differential Global Positioning System (DGPS) that allows sub-meter horizontal and vertical accuracy. For this project, a Trimble 4000 global positioning system (GPS) or similar device will be employed. The objectives for the sample station positioning require an accuracy of plus or minus 3 meters. To meet these requirements, the instrument calibration and quality control procedures described below will be followed.

The positioning system will be calibrated over a known location prior to the initiation of any field activities. Datum for all survey data will be reported under North American Datum 1983 (NAD83), Washington State Plane Coordinates (SPC), North 4601. National Geodetic Vertical Datum of 1929 (NGVD29) will be used as the vertical datum for survey data. Data deliverables will include latitude/longitude, northing/easting, and elevation, where applicable. Ecology's SEDQUAL database is maintained in SPC in feet NAD83 North Zone and Geographic Information System (GIS) maps use latitude/longitude decimal degrees projected into NAD83 North Zone. Locations will likely be displayed in these formats. A previously established, land-surveyed DGPS benchmark located near the sampling area will be used prior to initiating field sampling and daily to check the system accuracy.

All samples will be collected within 20 feet of the proposed sample coordinates. If an adequate sample cannot be collected within this radius, the Field Team Leader (FTL) may choose to move 50 feet from the proposed sample coordinates without notifying the Project Manager (PM). The new

location must be moved laterally and remain equidistant from the current cleanup boundary. No sample will be collected outside of a 50-foot radius from the proposed sample coordinates without prior consent from the PM.

Vertical elevation will be determined for all sample locations and will be reported as depth to sediment ([DTS] mudline). When applicable, the DTS will be measured before and after each sampling event. Measurements will be taken by weighted tape and echo sounder. The incremented tape will be pulled taut from the bottom and measured to the nearest tenth of foot. These measurements will then be confirmed with an electronic echo sounder onboard the vessel. The echo sounder method determines depth by bouncing sound waves off the mud layer and back to a receiver. These readings will be correlated to mudline elevations in mean lower low water (MLLW) datum to the nearest 0.1 foot using tide measurements obtained for Bellingham Bay for each of the sampling dates and times.

2.2 Surface Sediment Sampling

Surface sediment samples will be collected using a 0.1 square-meter stainless steel hydraulic van Veen sampler, operated by Marine Sampling Services (MSS). Surface sediment samples will be collected according to the procedures outlined in RETEC SOP 260 (Attachment A).

The surface sediment samples (0 to 12 centimeters [cm]) will be collected for the chemical, physical, and biological testing listed in Table 2-2. This table contains a list of analyte groups, along with analysis methods, holding times, preservatives, and container requirements. Table 2-3 provides a complete list of analytes measured as part of chemical analysis. Specific details on the sediment sampling procedures are described below. Visual classification of sediment samples will be according to the American Society for Testing and Materials (ASTM) standards listed in Table 2-4.

2.2.1 Sample Nomenclature

Each sediment sample location will be assigned a unique 6-digit alpha-numeric label. This 6-digit system will facilitate the identification and tracking of each unique sample. The code will be divided into the following sets of character designations as follows:

- The first characters identify the study location:
  - IJW - I & J Waterway;
- The next characters identify the type of sample taken and will be separated from the study location symbol with a dash (-):
  - SS – Surface Grab sample

- The final two characters identify a unique sample number according to location and will be separated from the previous characters by a dash (-):
  - 01-13 - Sites in the I & J Waterway
  - R1-R2 - Bioassay Reference Station samples
- Blind field duplicates will be identified as a unique sample location and/or sub-sample number (e.g., IJW-SS05-100)

An example ID for a surface grab at station 8 is "IJW-SS-08".

2.2.2 Surface Sample Collection

The *R/V Nancy Anne*, owned and operated by MSS, equipped with a modified hydraulic van Veen sampling device, will be used to collect surface sediment samples. Sampling locations will be approached at slow boat speeds with minimal wake to minimize disturbance of bottom sediments prior to sampling. Sediment samples will be handled carefully to minimize disturbance during collection and transportation to the laboratory.

The grab sampler will be lowered over the side of the boat from a cable wire at an approximate speed of 0.3 feet per second. When the sampler reaches the mudline, the cable will be drawn taut and DGPS measurements recorded. Each surface grab sample will be retrieved aboard the vessel and evaluated for the following acceptance criteria:

- Overlying water is present and has low turbidity;
- Adequate penetration depth is achieved;
- Sampler is not overfilled;
- Sediment surface is undisturbed; and
- No signs of winnowing or leaking from sampling device.

Grab samples not meeting these criteria will be rejected near the location of sample collection and steps repeated until criteria have been met. Deployments will be repeated within a 20-foot radius of the proposed sample location. If adequate penetration is not achieved after multiple attempts, less volume will be accepted and noted in the field notebook. Once accepted, overlying water will be siphoned off and a decontaminated stainless steel trowel, spoon, or equivalent, will be used to collect only the upper 12 cm of sediment from inside of the sampler without touching the sidewalls. The sampler will be decontaminated between stations and rinsed with Site water between grabs.

After sample collection, the following information will be recorded on the Field Log Sheet, Sediment Sampling Form, and/or the field notebook (Appendix B).

- Date, time, and name of person logging sample;
- Weather conditions;
- Sample location number and coordinates;
- Project designation;
- Depth of water at the location and surface elevation;
- Sediment penetration and depth;
- Sediment sample interval;
- Sample recovery; and
- Physical observations such as apparent grain size, color, odor, density, layering, anoxic contact, and presence of sheen, shells and/or debris.

2.2.3 Sample Processing

Sulfide samples will be collected from discrete grabs prior to compositing to minimize potential loss of volatiles. Each sulfide sample jar must be completely filled with sediments followed by 2 milliliters (ml) of ZnAc added on top. In addition, the sample jar must be sealed with a Teflon-lined cap to ensure proper preservation of the sample.

Homogenized sediment will be spooned immediately into appropriate pre-cleaned, pre-labeled sample containers, placed in coolers filled with ice or equivalent, and maintained at 4 degrees centigrade (°C). Materials over 0.5-inch-diameter and debris will be omitted from the sample containers. Any material removed from the sediment will be noted on the field forms. Surface sediment samples will be submitted for chemical analysis and bioassay testing.

In addition to the location information collected in the field, sample logging of bulk samples will involve physical characterization in general accordance with the visual-manual description procedure (Method ASTM D-2488 modified), details of which are provided in Table 2-4. Physical characterization includes the following:

- Grain size distribution;
- Density/consistency;
- Plasticity;
- Color and moisture content;
- Biological structures (e.g., shells, tubes, macrophytes, bioturbation);
- Presence of debris (e.g., woodchips or fibers, paint chips, concrete, sand blast grit, metal debris);
- Presence of oily sheen; and
- Odor (e.g., hydrogen sulfide).

This information will be recorded on the Sediment Sampling Forms (Attachment B).

Surface sediment samples collected for chemical and physical analysis will be packed and shipped to Analytical Resources, Inc. (ARI) in Tukwila, Washington, in accordance with RETEC SOP 110 (Attachment A). The surface sediment samples for bioassay analysis will be shipped under the same protocol to the bioassay laboratory, as appropriate.

2.2.4 Grain Size Rapid Wet Sieving

This process separates the sediment sample into size fractions greater than 62.5 micrometers (µm) (i.e., sand and gravel) and less than 62.5 µm (i.e., silt and clay) for rapid classification of sand and silt/clay fractions. This process helps determine appropriate reference stations with similar grain size fractions (by volume) during field operations. This procedure requires a 62.5-µm sieve, a funnel with diameter slightly greater than that of the sieve frame, a 100-ml graduated cylinder, a squirt bottle, a supply of distilled water, and a bowl for collecting rinse water.

- Place a 62.5-µm (4-phi or 0.0025-inch mesh or #230 mesh size) sieve in a funnel, with a bowl underneath. Moisten the sieve using a light spray of distilled water.
- Place exactly 50 ml of sample in the 100-ml graduated cylinder, add 20 to 30 ml of distilled water, and stir to fluidize the sample.

- Pour the sample into the sieve and thoroughly rinse any residue from the 100-ml graduated cylinder and stir into the sieve.

- Wash the sediment on to the sieve with distilled water using a water pique or squirt bottle having low water pressure. Aggregates can be gently broken using a rubber policeman.

- Continue wet sieving until only clear water passes through the sieve. Take care to ensure that the rinsate does not exceed approximately 950 ml. This is accomplished by sieving an appropriate sample quantity (i.e., a sample volume that is not too large) and by efficient use of rinse water. Both of these techniques may require experimentation before routine wet sieving is started.

- Upon completion of sieving, carefully return the contents (i.e., sand and gravel fraction) of the sieve to the 100-ml graduated cylinder.

- Tap the graduated cylinder gently to settle the solid material.

- Read the volume of solid material from the scale on the side of the graduated cylinder and record the value. The fraction of sample with grain size greater than 62.5 µm is the ratio of the volume of material retained in the sieve to the original volume (50 ml).

2.3 Reference Sample Collection

Toxicity testing requires that appropriate reference sediment be collected and tested with Site sediments. Concurrent test on reference sediment are conducted to control for possible sediment grain size effects on bioassay organisms. Bioassays will be run with reference sediment that is well matched to the test sediments for grain size and total organic carbon (TOC). One or more reference samples will be collected for bioassay analysis based on grain size and TOC content of Site samples.

Reference stations for bioassay testing are collected to analyze the response of the tests to sediments that are known to be unimpacted from chemical contamination. In addition, it is favorable to collect reference samples that have similar grain size distribution and TOC content as the sediment samples taken from the study area to assure that the reference stations are representative of the sediments in the study area. One reference station sample will be collected from Samish Bay, just south of Bellingham, in order to determine the response of bioassay test organisms to sediments of physical characteristics similar to those of the test sediments. Chemical testing will also be evaluated in the reference sediment to confirm test organism response is not due to chemical contamination.

2.4 Chemistry Analysis Methods

Sediment samples will be analyzed according to PSEP as outlined in the following methods, listed in Table 2-2:

- **VOCs:** VOCs by US EPA Method 8260;
- **SVOCs:** SVOCs by United States Environmental Protection Agency (EPA) Method 8270;
- **PCBs:** EPA Method 8081;
- **Metals:** Various metals by EPA Methods 6010/7471;
- **Conventional Parameters:** Total solids, total volatile solids, TOC, total sulfides, and ammonia by PSEP methods;
- **Bioassays:** Infaunal *Neanthes arenaceodentata* 20-day infaunal growth test, *Eohaustorius estuarius* 10-day acute mortality test, and sediment larval test with *Dendraster excentricus* or *Mytilus (edulis) galloprovincialis*; and
- **Grain Size:** By PSEP methods.

2.5 Bioassay Testing Methods

Marine bioassay testing species selection depends on grain size, salinity, and season in which testing will be performed. Based on the currently proposed project schedule, the following bioassay tests will likely be performed:

- *Neanthes arenaceodentata* (Los Angeles karyotype);
- *Eohaustorius estuarius, Rhepoxynius abronius, or Ameplisca abdita*; and
- *Dendraster excentricus* or *Mytilus (edulis) galloprovincialis*.

Bioassay testing will be performed according to PSEP guidelines (PSEP, 1995) by Vizon Scitec bioassay laboratory in Vancouver, British Columbia. Vizon Scitec is accredited by Ecology to perform each of the above testing procedures according to PSEP guidelines. If species substitutions are required due to the acceptability, availability, or other factors, such substitutions will be confirmed with Ecology prior to test initiation.

2.5.1 Species Selection

Amphipod Test

The amphipod *Rhepoxynius abronius* has demonstrated sensitivity to high percent fines in sediments, particularly high clay content sediments, and has exhibited mortalities greater than 20 percent in clean, reference area sediments (DeWitt et al., 1988; Fox, 1993). *Eohaustorius estuaries* has also exhibited sensitivity to high clay content (>30%) despite being relatively insensitive to salinity changes and other effects of grain size. *E. estuarius* will be the preferred amphipod species unless clays are greater than 30 percent clay. *A. abdita* is relatively insensitive to grain size up to concentrations of fines greater than 60 percent (USACE, 2000). If clay is greater than 30% and fines are greater than 60 percent, *A. abdita* will be the preferred amphipod test species. If clay is more than 30% and fines are less than 60%, *R. abronius* will be used for testing.

Larval Test

For the sediment larval test, adults must be collected in spawning condition or must be induced to spawn in the laboratory. Therefore, seasonality plays a role in selecting a test organism. The preferred species for larval testing is the sand dollar *Dendraster excentricus*. According to the Users Manual for the PSDDA program, *D. excentricus* spawns naturally in Puget Sound from April through December. Larvae of *D. excentricus* do not show an adverse response to increasing silt and clay fractions, and under conditions of expected high silts and clay, the sand dollar test is preferable (EPA, 1993). The bioassay laboratory has had success inducing spawning in *D. excentricus*, however, if spawning is unable to be induced, another species deemed acceptable for test sediments containing at least 60% fines is *Mytilus* (*edulis*) *galloprovincialis*. Although they spawn naturally in Puget Sound between March and July, (USACE, 2000), AMEC bioassay laboratory has had success inducing spawning in *M. galloprovincialis*.

Prior to initiating bioassay testing, sediment grain size and interstitial salinity will be determined to confirm selection of the appropriate test species. If there is headspace in the jars, nitrogen will be added prior to storage (PSEP, 1995).

2.5.2 Procedures

Amphipod Bioassay

This test involves exposing the amphipod *Rhepoxynius abronius* to test sediment for ten (10) days and counting the surviving animals at the end of the exposure period. Daily emergence data and the number of amphipods failing to rebury at the end of the test will be recorded as well.

Sediment Larval Bioassay

This test monitors larval development of a suitable echinoderm or bivalve species in the presence of test sediment. The test is run until the appropriate stage of development is achieved in a sacrificial seawater control (PSDDA MPR-Phase II, pp. 5-20). At the end of the test, larvae from each test sediment exposure are examined to quantify abnormality and mortality.

Initial counts will be made for a minimum of five 10-ml aliquots. Final counts for seawater control, reference sediment and test sediment will be made on 10-ml aliquots. The sediment larval bioassay has a variable endpoint (not necessarily 48 hours) that is determined by the developmental stage of organisms in a sacrificial seawater control (PSDDA MPR Phase II, page 5-20).

Ammonia and sulfides toxicity may interfere with test results for this bioassay. Aeration will be conducted throughout the test to minimize these effects.

Neanthes Growth Test

This test utilizes the polychaete *Neanthes arenaceodentata*, in a 20-day growth test. The growth rate of organisms exposed to test sediments is compared to the growth rate of organisms exposed to a reference sediment.

2.5.3 Negative Controls

Negative control sediments are used in the amphipod and *Neanthes* bioassays to check laboratory performance. Negative control sediments are clean sediments in which the test organism normally lives and which are expected to produce low mortality. The sediment larval test utilizes a negative seawater control rather than a control sediment. The negative control to be used for the sediment toxicity test will be a clean control (i.e., inert material with Site seawater) or native sediment where the organisms reside.

2.5.4 Reference Sediment

Reference sediments will also be included with each bioassay. Reference sediments provide toxicity data that can be used to separate toxicant effects from unrelated effects, such as those of sediment grain size and total organic carbon. Bioassay testing requires that test sediments be matched and tested simultaneously with an appropriate Ecology-approved reference sediment to factor out sediment grain size effects on bioassay organisms.

One or more reference samples will be collected from Samish Bay or a similar reference site in Washington if substantially different grain sizes and organic carbon contents are encountered in the Site sediment samples. Reference sediments will be collected using a 0.1-square-meter stainless van Veen grab

sampler deployed by boat. Upon reaching the designated reference sediment location, a test grab sample will be collected and a subsample will be wet-sieved to determine grain size. If the grain size is not appropriate, the vessel position will be adjusted and another test grab will be collected. This procedure will be conducted until sediments with the proper grain size have been located. Multiple grab samples will then be taken until enough reference sediment is collected. A subsample of the final composite will be wet-sieved to verify the appropriate grain size.

Locations of reference station coordinates will be reported, with an accuracy of ± 3 meters. Reference sediment samples will also be tested for total solids, total volatile solids, total organic carbon, grain size, ammonia, and sulfides.

2.5.5 Replication

Five laboratory replicates of test sediments, reference sediments, and negative controls will be run for each bioassay.

2.5.6 Positive Controls

A positive control will be run for each bioassay. The positive control to be used for the sediment toxicity test will be a toxic control in which a reference toxicant is used to establish the relative sensitivity of the test organism. Cadmium chloride will be the positive control reference toxicant used for the amphipod and juvenile polychaete bioassays. Copper sulfate will be the positive control reference toxicant used for the bivalve larvae bioassay.

2.5.7 Water Quality Monitoring

Bioassays require that proper water quality conditions be maintained to ensure survival of the organisms, and to ensure that undue stress is not exerted on the organisms unrelated to test sediments. Daily water quality measurements include salinity, temperature, pH, and dissolved oxygen for the amphipod and sediment larval tests. These measurements will be made every three days for the *Neanthes* bioassay. Ammonia and total sulfide concentrations in both porewater and overlying water will be measured at test initiation and termination for all three tests. Monitoring will be conducted for all test and reference sediments and negative controls (including seawater controls).

Parameter measurements must be within the limits specified for each bioassay. Interstitial salinity will be documented at test initiation for the amphipod bioassay. Measurements for each treatment will be made on a separate chemistry beaker set up to be identical to the other replicates within the treatment group, including the addition of test organisms.

3 Decontamination Procedures

Decontamination is performed as a quality assurance measure and a safety precaution. It prevents cross contamination between samples and helps to maintain a clean working environment. The purpose of decontamination is to remove contaminated materials clinging to gloves, boots, equipment, and sample containers prior to their removal from the work area. Decontamination also includes the removal and disposal of contaminated clothing and gloves.

Decontamination is achieved mainly by rinsing with soap or detergent solutions, tap water, deionized water, methanol, dilute acids, or acetone. Equipment will be allowed to air dry after being cleaned. Decontamination will be accomplished between each sample collection station and/or depth.

The following is a list of supplies needed provide decontamination of equipment and personnel:

- Clean gloves – inner and outer;
- Cleaning liquids and dispensers: soap and/or a powdered detergent solution such as Alconox™, tap water, deionized water, and technical grade hexane;
- Waste storage containers: drums, boxes, and plastic bags;
- Plastic ground cover;
- Chemical-free paper towels;
- Cleaning containers: plastic or galvanized steel pans and buckets; and
- Cleaning brushes.

3.1 Sampling Equipment

At a minimum, sampling equipment will be decontaminated prior to initial use and between sampling stations. Sampling equipment (i.e., spoons, bowls) decontaminated prior to field use will be wrapped in aluminum foil and stored in a sealed plastic bag to prevent contamination. Monitoring equipment (i.e., pH probe, tape measures) will be rinsed with distilled water and wiped dry with paper towels. Decontamination methods are detailed in RETEC SOP 120. Decontamination procedures include washing and scrubbing with an Alconox™ soap solution, rinsing with tap water, rinsing with distilled water, and air drying. If heavy, oily substances are found on sampling equipment, Simple Green™ or isopropanol will be used to clean the equipment. Cross

contamination will be minimized by sequencing sampling events from areas of suspected lower concentrations to areas suspected of relatively high concentrations, or from downstream to upstream locations as appropriate.

3.2 Personnel

RETEC has performed prior to sampling at the Site. The current investigations will be conducted under Level D protection (disposable Tyvek™ coveralls, steel-toe boots, hardhat, and protective gloves). The following steps will be used for personnel decontamination when using Level D equipment:

1) Wash boots and outer gloves with brush and detergent water, then rinse twice with tap water.

2) Remove disposable Tyvek™ coveralls, then remove outer gloves and place both coveralls and gloves in a disposal container.

3) Wash and remove inner gloves.

4) Wash and rinse face and hands with potable water or waterless cleaner.

5) Shower and shampoo as soon as possible at end of each workday.

All field participants must follow procedures and guidelines contained in the Site-Specific Health and Safety Plan. They must recognize the Site health and safety hazards and the protocols required to minimize exposure to such hazards by signing the Acknowledgement Form before beginning work.

3.3 Sediment Sampling Equipment

Equipment used to sample sediment that comes into contact with sediment will be decontaminated before collection of samples. The van Veen sampler will be decontaminated on site following methods outlined in RETEC SOP 120. The deck of the sampling vessel will be hosed down with site water in between sampling stations to minimize cross contamination and tracking of sediment to support zone areas.

4 Project Organization and Responsibilities

The specific roles, activities, and responsibilities of project participants are summarized below. The Port of Bellingham has the primary responsibility for managing the work completed at the Site. The primary contact for the Port is Mike Stoner. RETEC is the primary consultant for the Port and is responsible for the activities associated with implementing the supplemental sampling. The daily management of the project will be completed by RETEC staff members including Mark Larsen (PM) and Dan Berlin.

4.1 Project Team

The following additional personnel have been identified for the field investigation.

Field Team Leader

The FTL, Nick Bacher, will support the PM. The FTL is responsible for implementing and coordinating the day-to-day activities of the field team, including health and safety in the field. The FTL will report directly to the PM and will:

- Implement field-related work plans and schedules;
- Coordinate and manage field staff;
- Implement QA/QC for technical data provided by the field staff including field-measurement data;
- Conduct peer reviews of the field performance and reporting products of field crews;
- Write and approve text and graphics required for field-team effort;
- Coordinate and oversee technical efforts of subcontractors assisting the field team;
- Identify problems at the field-team level, resolve issues in consultation with the PM, implement and document corrective action procedures, and communicate with team members and upper management; and
- Participate in preparation of the project deliverables.

The field technical staff will be utilized to mobilize equipment, obtain samples, and gather field data. All designated technical team members will be experienced professionals who possess the degree of specialization and

technical competence required to effectively and efficiently perform the required work.

Project Manager

The PM, Dan Berlin, is responsible for ensuring completion of project objectives and Quality Assurance (QA) standards. The PM communicates with the Port and DNR and manages schedule, budget, and resources.

Quality Control Manager

The Quality Control Manager (QCM), Jennifer Fetting, for this project will review and document project performance as it relates to the Work Plan. He will be supported by Anne Fitzpatrick, RETEC's Technical Advisor for the project. As appropriate, the QCM will:

- Assist with laboratory coordination for scheduled analyses;
- Assure that the specified field, analytical, and data management procedures are followed and documented;
- Assess the precision, accuracy, and completeness of the data derived from the investigations;
- Schedule and oversee data validation; issue laboratory audit reports; retain laboratory audit records; and follow up on corrective actions; and
- Finalize electronic data deliverables (EDDs) and import data into the project database.

Health and Safety Officer

The Office Health and Safety Officer will be responsible for the health and safety aspects of this project.

Subcontractors

Local subcontractors will be used as appropriate and when available, without compromising quality, schedule, and cost.

Samples will be collected by RETEC. Chemical analyses of all media and physical analysis will be conducted by ARI, of Tukwila, Washington. Vizon Scitec of Vancouver, British Columbia, will be responsible for biological analysis. Individual laboratory QAPPs and SOPs for each laboratory are on file at RETEC.

MSS of Burley, Washington, under the direction of Bill Jaworski, will be responsible for the sediment collection for the investigation.

4.2 Special Training Requirements/Certification

Specific training requirements for performing fieldwork at the Site are as follows:

- All field personnel assigned to the Site must have successfully completed 40 hours of training for hazardous site work in accordance with Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.120(e)(3) and be current with their 8-hour refresher training in accordance with OSHA 29 CFR 1910.120(e)(8). Documentation of OSHA training is required prior to personnel being permitted to work on Site.

- Personnel managing or supervising work on site will also have successfully completed 8 hours of manager/supervisor training meeting the requirements of OSHA 29 CFR 1910.120(e)(4).

- Personnel assigned to the site must be enrolled in a medical surveillance program meeting the requirements of OSHA 29 CFR 1910.120(f). Personnel must have successfully passed an occupational physical during the past 12 months and be medically cleared to work on a hazardous waste site and capable of wearing appropriate personal protective equipment (PPE) and respiratory protection as may be required.

- Personnel assigned to the site who must wear a respirator must be familiar with the OSHA respiratory standard (29 CFR 1910.134). Personnel who are required to wear respirator protection must have successfully passed a respirator fit test within the last 12 months.

It is the responsibility of the employing organization to provide their employees with the required training, medical monitoring, and fit testing prior to assigning them to work at this site. Each employing organization will be responsible for providing documentation of training, monitoring, and fit testing (with make/model of respirator) to the RETEC Project Manager and Field Team Leader prior to sending their employees to the site to work.

All field participants must follow procedures and guidelines contained in the Site-Specific Health and Safety Plan (HASP). The HASP will be completed and submitted to Ecology 30-days prior to initiation of field sampling. All participants in the sampling effort must recognize the site health and safety hazards and the protocols required to minimize exposure to such hazards by signing the Acknowledgement Form before beginning work.

5 Quality Assurance/Quality Control Plan

To verify that the data produced during the sediment investigation are of sufficient quality, specific QA/QC requirements will be addressed by field personnel and the analytical laboratory. All laboratory data will be validated, as described below, prior to their use in project reporting.

5.1 Field QA/QC Protocol and Record Keeping

Proper sample collection, identification, preservation, storage and handling procedures, and chain of custody records are necessary for sampling data to be valid and usable. Procedures for these steps are discussed in the previous sections of this sampling plan. The field sampling crew is also responsible for ensuring that the required QA/QC analyses are requested, as indicated in Table 5-1.

5.1.1 Documentation

In addition to sample labels and chain of custody forms, a field logbook will be maintained by the field supervisor to provide a daily record of significant events. All entries will be signed and dated, made in nonerasable ink, and errors will be crossed out and initialed with a single line. The logbook will be kept as a permanent record. All field measurements will be recorded on the appropriate sampling log forms.

5.1.2 Sample Chain of Custody

Samples are considered to be in one's custody if they are: (1) in the custodian's possession or view; (2) in a secured location (under lock) with restricted access; or (3) in a container that is secured with an official seal(s) such that the sample cannot be reached without breaking the seal(s). The principal documents used to identify samples and to document possession are chain of custody (COC) records, field logbooks, and field tracking forms. COC procedures will be used for all samples at all stages in the analytical or transfer process and for all data and data documentation, whether in hard copy or electronic format.

5.1.3 Location Control

DGPS locations and sampling times will be recorded electronically and on the project sampling logs. The DGPS system will be checked using the control point established for the project at least once daily. Any variability of measurements will be recorded in the field logbook. Measurements of water depth will be repeated, with the depth measured to the nearest 0.1 foot. After tidal corrections, mudline elevations will be reported to the nearest 1.0 foot.

5.2 Laboratory QA/QC Requirements

Sediment samples will be stored and analyzed in accordance with the holding time requirements of PSEP (Table 2-2). QA/QC samples will be performed in accordance with PSEP (1996d) and Table 5-1.

At a minimum, the laboratory will comply with the QA/QC requirements shown in Table 4-1. In addition, the analytical laboratory also has separate, instituted internal QA/QC plans. Analyses will be required to conform to accepted standard methods and rigorous internal QA/QC checks prior to final approval and reporting by the laboratory.

The analytical laboratory will provide data reports that will include a cover letter describing any problems or deviations from standard protocols, analytical results, and associated QA/QC materials. The laboratory will retain electronic data necessary to report chromatograms for each sample, mass spectra of detected target compounds, calibration summaries, appropriate sample information (weights, final volumes, and dilutions), and the results of the QC samples.

The final report will include QA2 deliverables, surrogate recoveries where appropriate, and sample chain of custody information (as required by Ecology for SEDQUAL database). Any QA problems (i.e., calibrations, internal standards) must be noted in the laboratory report narrative. Chemical data will be qualified in accordance with PSEP guidelines. The "J" qualifier will be applied to all concentrations that fall between the reporting detection limit (RDL), or practical quantitation limit (PQL) and the laboratory's method detection limit (MDL). Dilution volumes, sample sizes, percent moisture, and surrogate recoveries will be presented on each summary sheet with the analytical results in the data packages. Similar information will also be assembled for each QC sample (method blanks, matrix spikes, etc.).

5.3 Chemical Data Validation

RETEC will review all raw data to verify that the laboratory has supplied the required QA/QC deliverables. The data will then be validated against QA2 level review for acceptable inclusion into the regional SEDQUAL database. All data will be submitted to Ecology's Sediment Management Unit in electronic SEDQUAL format prior to final approval of the report. The review will be performed using EPA CLP guidelines, RETEC SOP 410 (Appendix A), and methods specified in this SAP. QA review of conventional data will be performed using the Data Validation Guidance Manual by PSEP.

The review will evaluate the data for completeness, format, holding conditions, and laboratory QA sample results (e.g., blanks, matrix spikes).

The data validation will also include a review of surrogate recovery values for each of the organic samples. Data validation checklists will be prepared.

Where data fail criteria provided in the QA2 manual, the laboratory will be contacted, and the data will be: (1) reanalyzed, (2) qualified, or (3) discarded. Data quality issues will be summarized in a data validation report.

5.4 Bioassay Data Quality Review

A review of the bioassay tests that will be conducted on surface sediment samples collected from Bellingham Bay is necessary to confirm that appropriate and thorough laboratory testing procedures and documentation procedures were followed. Bioassay test data should be compiled and reviewed for validity using the appropriate guidelines and directives set forth in this SAP, and data should be reported according to the established QA/QC procedures. The bioassay laboratory should document and provide an explanation of any exceptions to the established procedures. Overall data usability must be determined if any of the bioassay results are to be used in the decision-making process.

The data quality review will compare bioassay testing holding conditions, test setup, test implementation, and test termination to pertinent bioassay protocols. The review of test setup procedures includes reference sediment collection, organism procurement, number of organisms, number of replicates, volume of sediment, and general test initiation conditions. The review of test implementation includes an evaluation of standard parameters like the length of photoperiod, type of aeration, water replacement, and other daily monitoring variables, including the validity of test termination procedures. It also includes summaries of information pertinent to negative and positive control samples and reference sediment relative to requirements for test success.

The bioassay test validation is based on a RETEC Level II verification protocol. RETEC Level II data verification protocol is followed for preliminary site investigations or ongoing site monitoring events that do not require full documentation and data validation. With Level II data validation, the laboratory is entrusted to follow all internal quality control procedures (i.e., calibrations, performance checks) as directed in the analytical methods reported. A definitive assessment of analytical precision, accuracy, and completeness can be made.

Composited surface samples will be collected for both sediment chemistry analyses and bioassay tests. Samples for bioassay testing will be sent to Vizon Scitec for the following bulk sediment toxicity tests:

- *Eohaustorius estuarius* 10-day mortality;

- *Neanthes arenaceodentata* 20-day growth; and
- *Dendraster excentricus* sediment larval test.

Checklists will be used during bioassay test validation to assess the acceptability of the following major test elements:

- Custody, preservation, and holding times;
- Test setup;
- Implementation, including test, control, and reference samples; and
- Reporting.

6 Field Data Management and Reporting

6.1 Field Data Management

Field measurements and observations recorded in field notebooks, on field data forms, or on similar permanent records by field technicians are to become part of the permanent file. Field data is to be recorded directly and legibly in the notebooks or forms with all entries signed and dated.

Managerial documentation consists of:

- Data processing and storage records;
- Sample identification and chain-of-custody records;
- Field changes and variances;
- Document control, inventory, and filing records;
- QA/QC records;
- Health and safety records; and
- Financial and project tracking records.

6.2 Field Data Evaluation

Initial responsibility for verification of accurate entries will lay with the field data logger. At the end of the sampling day, the data logger must sign and date the notebook. Data will then be verified by the FTL or PM, who will review all collected data to ensure that all pertinent information has been entered, and that correct codes and units have been used. The FTL will direct the field data logger to make any necessary corrections to the record and initial them.

After data are reduced into tables or arrays, the task managers will review data sets for anomalous values. Any inconsistencies will be resolved by seeking clarification from the field personnel responsible for data collection.

Managerial and technical data will be verified by the PM for reasonableness and completeness. Random checks of sampling and field conditions will be made by the task managers. The designated QA officer will review selected field data and procedures during random site visits to ensure adherence to the SAP and RETEC SOPs. Whenever possible, peer review will also be incorporated into the data evaluation process in order to maximize consistency among field personnel. All data evaluation will be verified by a dated signature.

The QA officer will monitor and audit performance of the QA procedures to assure that the project is performed in accordance with approved quality assurance procedures. The QA officer or authorized representative will

conduct audits to evaluate the execution of sample identification, field notebooks, and sampling procedures. The field audit program will have preventative maintenance procedures to ensure vital equipment is functioning properly. These procedures include cleaning/decontamination of equipment, daily visual inspection, and routine maintenance of parts depending on the type of equipment used.

6.3 Corrective Actions

The purpose of the evaluation process is to qualify or eliminate field information or samples that were not collected or documented in accordance with specified protocols outlined in the SAP/SOP. The Field Team Leader will review the procedures being implemented in the field for consistency with the established protocols. Sample collection, preservation, labeling, etc., will be checked for completeness. Where procedures are not in compliance with the specified protocols, the deviations will be field documented and reported to the Task Manager. Corrective actions will be defined by the Field Team Leader and Task Manager and documented and implemented as appropriate.

6.4 Field Sampling Quality Control Report and Schedule

At the end of the field investigations, a report will be prepared and submitted to the task manager. This report will include copies of the field notebook, Chain-of-Custody Forms, or any other pertinent field records. Any deviations from the SAP or SOPs that will result in a compromise of the project goals will be flagged and discussed in the report.

7 References

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